PROCEEDINGS OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

HELD AT PHILADELPHIA, FOR PROMOTING USEFUL KNOWLEDGE.

VOL. X. 1866. No. 76.

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PROCEEDINGS

OF THE

AMERICAN PHILOSOPHICAL SOCIETY.

VOL. X. JUNE, 1866. No. 76.

Stated Meeting, June 15, 1866.

Present, thirteen members.

Vice-President PROF. CRESSON in the Chair.

Letters of envoi were received from the Prussian Academy, dated Berlin, November 24th, 1865, and the Holland Society of Sciences at Harlem.

Letters accepting membership were received from Dr. D. F. Sandberger, dated Wurzburg, May 13th, and Mr. T. Davidson, dated Park Crescent, Brighton, England, May 9th, 1866.

Photographs of Mr. Joseph Harrison, and Prof. E. O. Kendall, were received for insertion in the Album.

A letter was received from Prof. T. C. Porter, President Linnæan Society, Lancaster, Pennsylvania, announcing the transmission of boxes containing plaster casts of the Indian sculptures on an island in the Susquehanna. The Secretary announced the receipt of the boxes, and the casts were distributed around the Hall of the Society. Prof. Porter being present, gave a short history of the discovery of these interesting remains, and the difficulties to be overcome in obtaining casts of them. On motion the Secretaries were instructed to tender the thanks of the Society to the Linnæan Society at Lancaster, for this very fine donation to its cabinet; and on motion of Mr. Fraley, the collection of casts was referred for examination to a Special Committee and instructed to report, consisting of Mr. Peale, Dr. Emerson, and Prof. Porter.

A letter to the President, from Rev. Thomas D. Allen, was read, dated N. Cevney Rectory, Cirencester, England, May 12th, requesting information respecting certain human fossil bones reported to be in the cabinet of the Society.

A circular letter was read announcing the partial destruction of the Library, Museum, &c., of the new Chicago Academy of Sciences, on the 6th inst.

A letter was read addressed to Prof. Joseph Henry of the Smithsonian Institution, from Col. James Greer, dated Dayton, Ohio, May 8th, 1866, respecting his discovery of three fossil fish, which he states he detected embodied in compact sand in a narrow deep cut of the Sand "Bluffs" or Loess of the Mississippi near Vicksburg, on the 19th March, 1866, which he has preserved. He believes it to be the first discovery of fossil fish in the Loess of the Mississippi.

A letter was received from the Rev. George Belcourt, dated Rustico, Prince Edward Island, May 10th, explaining and giving specimen MS. pages of his Odjibowe-Francois vocabulary, which, on motion, was referred to a special committee consisting of Dr. Hayden, Mr. Lesley, and Mr. P. E. Chase.

Donations for the Library were received from Dr. Roehrig, the Prussian Academy, Upper Lausatian Society, German Union of Physicians and Naturalists, Prince of Wied, London Astronomical, Meteorological, and Chemical Societies, Dublin Geological Society and Journal of Science, Essex Institute, Boston Society of Natural History, and American Antiquarian Society, Franklin Institute, Medical News and Academy of Natural Sciences at Philadelphia, Chicago Academy of Sciences, Mr. Isaac Lea, and Mr. Paynter, of Media, Pennsylvania.

Copies of the Proceedings No. 75, were distributed to the members present.

A copy of the "Poissons Fossiles" published at Neuchatel, 1833 and 1843, was laid upon the table, received from Alex. Agassiz, in exchange for xiii vols. of the Transactions of the Society, forwarded to the Museum of Comparative Zoology, Cambridge, Massachusetts.

The death of Dr. John Lindley, November 1st, 1865, aged 66, was announced by the Secretary.

The death of Prof. H. D. Rogers, at Glasgow, May 29th, aged 56, was announced by Mr. Fraley, on whose motion, Dr. R. E. Rogers was appointed to prepare an obituary notice of the deceased.

A paper was presented for publication in the Transactions, entitled Notes upon the Geology of some portions of Minnesota, from St. Paul to the western part of the State, by James Hall (with diagrams), which, on motion, was referred to a committee consisting of Prof. Trego, Dr. Hayden, and Mr. Lesley.

Prof. Cresson described two remarkable cases of lightning-stroke which occurred during a recent storm.

The Secretaries reported that they had procured an Album, pursuant to orders, and exhibited the same with the Photographs of members arranged in it, so far as they have been received.

New nominations Nos. 550, 551, 552, 553 and 554, were read.

And the Society was adjourned.

Stated Meeting, July 20, 1866.

Present, five members.

Dr. Carson in the Chair.

Photographs of Dr. Torrey, Dr. Dewey, and Dr. Shurtleff, were presented for insertion in the Album.

A letter was received from the American Antiquarian Society, dated Worcester, Massachusetts, July 5th, 1866, reporting deficiencies in its series of publications of the Society.

A letter was read from Dr. Schinz, dated Strasbourg, 15th June, 1866, acknowledging the receipt of diploma and publications of the Society; and communicating certain results of

physical experiments with his improved pyrometer, and researches into the proportion of draft to the surfaces of fuel.

A letter was read from Professor E. N. Horsford, dated Cambridge, July 10th, 1866, giving an account of a remarkable rainbow as follows:

On Sunday the 8th instant, we witnessed here a rainbow of rare brilliancy and multiplication. It was at the close of a severe thundergust, accompanied by a violent shower just before sunset. The arch was maintained throughout, but in some parts less brilliant than in others. The part extending some forty degrees on either side of the summit, rested on a luminous, fleecy cloud as a background, contrasting singularly with the darker clouds below. Over all this portion it was easy to distinguish the primary and secondary bows. In short sections there was a duplicate secondary bow, or at least the red division. This was novel to me. But within the primary bow, in which all the colors were wonderfully brilliant, there were in some short sections no less than five repetitions of the red division of the spectrum. Each succeeding one was fainter from without inward, and less remote from its nearest outer companion. The whole width of the five red divisions was scarcely twice the width of the primary bow. Pouillet speaks of a third and fourth bow, but here were no less than eight.

Donations for the Library were announced from the Geographical Societies of St. Petersburg and Paris; the Bureau des Mines; the Astronomical Society of London; the Boston Natural History Society, and the American Academy; the Massachusetts and New Hampshire Historical Societies; Harvard College; Professor Horsford; the New York Lyceum; the Polytechnic College at Philadelphia; Medical News; Friends' Freedmen Relief Association; the Union League; Ohio Mechanics Institute; St. Louis Academy of Sciences; and the Superintendent of Public Instruction in California.

A copy of the Catalogue of the books of the Society, part II, just published, was laid upon the table for examination by the members.

The decease of a member, Dr. Paul Beck Goddard, July 5th, aged 57, was announced by Professor Kendall.

The Committee to which was referred the paper of Prof. James Hall on the Geology of part of Minnesota reported in favor of its publication in the Transactions, and the subject was referred to the Committee of Publication with authority to diminish the number of engraved diagrams if they think proper.

The Committee to which was referred the communication of Mr. Belcourt, respecting an Odjibowe vocabulary, reported in favor of publication, which was so ordered.

Specimens of titaniferous iron ore from Cumberland, R. I., were laid on the table by Mr. Chase.

Pending nominations Nos. 550, 551, 552, 553 and 554, were read.

And the Society was adjourned.

Stated Meeting, August 17, 1866.

Present, three members.

Professor TREGO in the Chair.

Letters acknowledging the receipt of publications were received from the Royal Saxon Society, September 30th, 1865; the Batavian Society of Experimental Philosophy, October 21st; the Geological Society at Berlin, November 4th; the Natural History Union of the Duchy of Nassau, October 10th; the Zoological and Botanical Society at Vienna, January, 1866; the Asiatic Society at London, March 26th; the Linnæan Society at Bordeaux, June 8th; Yale College, July 24th; New York Historical Society, July 31st; American Antiquarian Society, August 1st; Harvard College, August 1st; State Historical Society of Wisconsin, August 2d; New York Lyceum, August 7th; and New Jersey Historical Society, August 12th, 1866.

Donations for the Library were announced from the Berlin Academy; the Royal Italian Commission to the Dublin Exposition of 1865; the Paris and London Geographical So-

cieties; the London Astronomical, Meteorological, and Geological Societies; the Essex Institute; Hartford Asylum; American Journal of Arts and Sciences; Rensselaer Polytechnic Institute; Prof. Winchell; Franklin Institute; and Medical News of Philadelphia.

The Proceedings of the Board and Council were read.

Pending nominations Nos. 550, 551, 552, 553 and 554, were read.

And the Society was adjourned.

Stated Meeting, September 21, 1866.

Present, ten members.

Vice-President Prof. CRESSON in the Chair.

The printed circular of the Officers and Committee of the Portland Natural History Society, appealing for aid, was read.

A letter was received from Mr. Wm. Duane, 514 Walnut Street, September 20th, presenting to the Library of the Society, four MS. volumes of a Journal kept by the late Mr. Peter Legaux, superintendent of the Vineyard at Spring Mill, Montgomery County, Pennsylvania, between the years 1803 and 1827. The gift was made under the belief that the meteorological records contained therein are of value.

Letters of envoi were received from the Geographical Society of St. Petersburg, July 25th; the University at Lund, November, 1865; the Verein fur Erdkunde zu Dresden, May 16th; the Provincial Secretary of Canada at Ottawa, August 31st; and the Boston Society of Natural History, September 17th, 1866.

On motion ordered that the Verein fur Erdkunde zu Dresden, be added to the list of corresponding Societies to receive the Proceedings.

Donations for the Library were received from various sources as follows: the Royal, Danish, Russian, Austrian, Turin,

and Dublin Societies; the University of Lund; the Observatory at Turin; the Geographical Societies at St. Petersburg, Dresden, Paris, and London; the Geological Societies at Vienna, Berlin, and Leeds; the Zoologico-Botanical Societies at Vienna, Berlin, and Frankfort-am-Maine; the Natural History Societies at Bremen, Bonn, and Boston; the Academy of Natural Sciences, Philadelphia; the Geological Survey of Canada; American Journal of Sciences; Cooper Union; Historical Magazine at Morrisiana; the Medical News; J. A. Meigs, M. Carey Lea, and Wm. Duane, of Philadelphia; Dr. Steiner, of Baltimore; Prof. Dana, of New Haven; Dr. Schinz, of Strasbourg; M. des Moulines, and M. Trimoulet, of Bordeaux; Mr. Alex. Winchell, of Ann Arbor; and the California Academy.

The decease of a member, Mr. Matthias W. Baldwin, in Philadelphia, on the 7th inst., was announced by Mr. Fraley. On motion, Mr. Franklin Peale was appointed to prepare an obituary notice of the deceased.

The decease of another member, Dr. A. A. Gould, at Boston, Massachusetts, on the 17th inst., aged 57, was announced by Mr. T. P. James.

Prof. H. C. Wood offered for publication in the Transactions, a paper entitled "A Contribution to the Knowledge of the Flora of the Coal Period of the United States," which, on motion, was referred to a committee consisting of Mr. Lesquereux, Mr. T. P. James, and Mr. Lesley.

Mr. P. E. Chase read a communication "On the Relations of Temperature to Gravity and Density:"

It has long been known that the temperature of the air is, to some extent, dependent upon its gravity and density. Among the prominent indications of this dependence are:

1. The diminution of temperature upon mountains and in balloon ascents.

2. The equation of oscillation ($v = \sqrt{2\,gh}$), which applies to all undulations, whether of heat, light, electricity, or material bodies.

3. The inverse relations of specific gravity and atmospheric density to temperature, and the direct relation of density to pressure.

4. The observed proportionality of the heat generated by collision, to the square of the obstructed velocity, in falling bodies as well as in projectiles.

5. The relations which have been pointed out between magnetism and heat,—between magnetism and the solar spots,—between the sun-spots and gravity,*—and between magnetism and gravity.

6. The general theoretical proportionality of radiative to absorptive power, and the practical confirmation of theory by Tyndall's recent experiments.

7. The variation of heat, gravity, and other central forces, in the inverse ratio of the square of the distance, and the reasonable presumption of an identity of mechanical laws from the identity of the "lines of force" in centripetal and centrifugal radiation.

The average daily extremes of temperature, from the absorption of solar heat and the cooling by nocturnal radiation, occur at about 5^h A.M. and 2^h P.M. The atmospheric gravity, in consequence of the combined attraction of the sun and earth, is greatest at midnight and least at noon. The temperature- and weight-disturbances do not, therefore, correspond in their daily march, but by averaging on each side of the turning-points (so as to eliminate, as far as practicable, the overlying perturbations of the heat which is alternately stored and restored), we may discover some indications of a constant ratio between the radiating and attractive energies of the sun. If such a ratio really exists, and yet cannot be exactly determined, the nearest attainable approximation to its value will be an interesting, and, perhaps, a useful addition to our knowledge of molecular physics.

The "interior work" or latent heat that balances the condensation of gravity, is greatest at midnight, when the solar attraction is added to the terrestrial, and least at noon, when the weight of the air is represented by the difference of the two attractions. It seems probable, therefore, inasmuch as the gravitation of a particle towards the sun is .00067 as great as that towards the earth's centre, and as a variation of 180° F. in temperature is accompanied by a variation of .367 in volume, that there should be, from this cause alone, an in-

* Wolff's sun-spot formula is based on the masses, distances, and annual motions of Jupiter, Saturn, the Earth, and Venus.

crease in temperature, under a vertical sun at noon, of $180° \times .00067 \div .367 = 0°.3286$, and a like decrease at midnight. This amount of disturbance is entirely independent of the heat-waves which are radiated from the sun, and it would, therefore, remain unchanged, even if the sun were darkened or an adiathermanous screen were interposed.

If the hypothesis of a constant ratio between the solar attraction and the solar radiation is correct, the average temperature at different hours of the day, like the weight-disturbance, should vary nearly as the cosine of the hour-angle. In Table I, the stations are arranged, in each quarter of the globe, in the order of latitude, and one hour is allowed for the lagging which is due to atmospheric inertia,* the differences being taken between 1^h and 13^h, 2^h and 12^h, &c., instead of between 0^h and 12^h, 1^h and 11^h, &c. The striking theoretical correspondence in the average of the joint observations at Göttingen and Halle, is specially interesting on account of the position of the two stations, south of the Hartz Mountains, and near the opposite extremities of the range. The New Haven ratios, which are deduced from the discussion, by Profs. Loomis and Newton, of 86 years' observations, approximate more nearly to the cosine ratios than those which are based on a shorter series of observations at most other American stations. The Amherst ratios, however, representing a single year's observations under the direction of Prof. Snell, are very noticeable for their close coincidence with theory. At nearly all the stations the abnormal differences are greatest when the sun is near the horizon, which may be partly owing to the greater extent of air traversed by the solar rays.

The force of gravity at the poles is $1^2 - (\frac{299}{300})^2 = \frac{1}{150}$ greater than at the equator. The amount of heat required to expand air $\frac{1}{150}$ of its volume is $180° \times \frac{1}{150} \div .367 = 3°.27$. According to Johnston's Physical Atlas, the mean minimum temperature of the globe is $1°.75$, the maximum $85°.3$, which indicates an average difference of $83°.55$ between the polar and equatorial temperatures. Daguin (Traité de Physique, v. 2, p. 115) fixes the range at $46°.2$ C., or $83°.16$ F.

Table II exhibits the average daily range, at all the stations of hourly observation which are embraced in the third edition of Guyot's Tables.

* The approximate average lagging, as shown by a great variety of barometric observations, is about 50 minutes.

Tables III and IV are constructed from Prof. Coffin's reductions of the extensive meteorological observations made under the direction of the United States Patent Office and the Smithsonian Institution.

Table V presents various comparisons between the thermal dis-

TABLE I.—RATIOS OF AVERAGE DAILY FLUCTUATIONS OF TEMPERATURE.

	Hours of Observation,	1 13	0—14 2—12	23—15 3—11	22—16 4—10	21—17 5— 9	20—18 6— 8
	Hour Angle,	0°	15°	30°	45°	60°	75°
	Cosine of Hour Angle,	1.	.966	.866	.707	.500	.259
Average Temperature Ratios.	Philadelphia,[f 2]	1.	.984	.912	.795	.612	.347
	Do.[f 3]	1.	.980	.912	.796	.610	.349
	Do.[d]	1.	.969	.920	.808	.615	.338
	Frankford,[f 4–5]	1.	.983	.933	.824	.631	.338
	New Haven,[e]	1.	.978	.905	.775	.567	.302
	Amherst,[f 5]	1.	.964	.859	.703	.504	.257
	Toronto,[a]	1.	.978	.927	.823	.655	.363
	Do.[f 6–7]	1.	.989	.950	.842	.644	.351
	Do.[f 8]	1.	.987	.920	.819	.653	.365
	Sitka,[f 11]	1.	.979	.879	.719	.554	.288
	Boothia Felix,[f 12]	1.	.956	.840	.668	.461	.234
	Rio Janeiro,[f 16–17]	1.	.976	.917	.786	.586	.314
	Trevandrum,[f 18–19]	1.	.973	.896	.755	.551	.293
	Madras,[f 20–24]	1.	.981	.883	.744	.547	.315
	Bombay,[f 22–23]	1.	.980	.919	.774	.575	.307
	Do.[f 25]	1.	.989	.915	.789	.594	.345
	Calcutta,[f 26]	1.	.981	.883	.717	.536	.272
	Peking,[f 28]	1.	.975	.877	.752	.551	.289
	Tiflis,[f 27]	1.	.965	.882	.739	.537	.279
	Nertchinsk,[f 29]	1.	.971	.886	.748	.549	.286
	Do.[f 30]	1.	.984	.906	.764	.567	.299
	Barnaul,[f 31–32]	1.	.971	.887	.743	.537	.299
	Do.[f 33]	1.	.974	.889	.740	.532	.271
	Rome,[f 34]	1.	.988	.935	.816	.614	.334
	Padua,[f 35]	1.	.987	.916	.784	.595	.293
	Do.[c]	1.	.987	.909	.784	.594	.294
	St. Bernard,[f 38]	1.	.968	.867	.706	.501	.259
	Geneva,[f 36]	1.	.970	.880	.731	.527	.275
	Salzburg,[f 41]	1.	.977	.888	.746	.543	.292
	Kremsmünster,[f 40]	1.	.965	.868	.745	.503	.262
	Munich,[f 42]	1.	.972	.894	.761	.562	.311
	Prague,[f 43]	1.	.970	.895	.751	.553	.317
	Do.[f 44]	1.	.963	.867	.706	.469	.243

[a] Sabine. [c] Kaemtz. [e] Loomis.
[b] Blodgett. [d] Bache, 1842–4. [f] Guyot.

turbances which are set forth in the previous tables, and contemporaneous disturbances of gravity or density. It exhibits a satisfactory degree of uniformity in the variously derived results, considering the limited extent of the observations, the usual crudity of first approximations in science, and the amount of disturbance that must necessarily arise from atmospheric currents. The ratios, whether

TABLE I.—*Continued.*

	Hours of Observation,	1 13	0—14 2—12	23—15 3—11	22—16 4—10	21—17 5— 9	20—18 6— 8
	Hour Angle,	0°	15°	30°	45°	60°	75°
	Cosine of Hour Angle,	1.	.966	.866	.707	.500	.259
AVERAGE TEMPERATURE RATIOS.	Plymouth,[f 45–46]	1.	.973	.891	.744	.542	.281
	Brussels,[f 47]	1.	.972	.896	.759	.554	.294
	Mühlhausen,[f 50]	1.	.984	.889	.730	.523	.276
	Greenwich,[f 53]	1.	.964	.863	.705	.496	.257
	Do.[f 54]	1.	.979	.874	.721	.521	.279
	Do.[b]	1.	.974	.879	.726	.521	.268
	Halle,[f 55]	1.	.959	.849	.679	.470	.205
	Do.[c]	1.	.964	.856	.689	.475	.238
	Göttingen,[f 56]	1.	.974	.887	.732	.529	.270
	Do.[c]	1.	.976	.888	.732	.530	.278
	Halle and Göttingen,[f]	1.	.966	.869	.716	.500	.240
	Do.[c]	1.	.971	.873	.712	.504	.259
	Utrecht,[f 51]	1.	.966	.879	.749	.557	.290
	Salzuflen,[f 58]	1.	.991	.910	.786	.580	.310
	Berlin,[f 57]	1.	.964	.889	.743	.540	.280
	Stettin,[f 59]	1.	.963	.918	.756	.535	.290
	Apenrade,[f 60]	1.	.961	.866	.727	.525	.274
	Makerstoun,[f 63]	1.	.965	.879	.727	.515	.262
	Leith,[f 61–62, c]	1.	.988	.901	.756	.572	.316
	Catharinenburg,[f 65]	1.	.974	.893	.751	.544	.318
	Do.[f 66]	1.	.977	.898	.752	.543	.282
	Christiania,[f 71]	1.	.972	.886	.748	.521	.274
	St. Petersburg,[f 67]	1.	.954	.884	.762	.562	.285
	Do.[f 69]	1.	.969	.935	.816	.626	.336
	Helsingfors,[f 68]	1.	.968	.872	.718	.514	.262
	Do.[f 70]	1.	.980	.891	.750	.546	.289
	Drontheim,[f 72]	1.	.942	.815	.651	.439	.222
	Strait of Kara,[f 73]	1.	.969	.871	.707	.502	.261
	Novaia Zemlia,[f 74]	1.	.958	.835	.655	.442	.226
	St. Helena,[f 76]	1.	.952	.852	.693	.465	.229
	Do.[a]	1.	.967	.852	.678	.460	.207
	C. of Good Hope,[f 77]	1.	.948	.870	.732	.527	.264
	Hobarton,[f 78,a]	1.	.965	.870	.724	.520	.267

[a] Sabine. [c] Kaemtz. [e] Loomis.
[b] Blodgett. [d] Bache, 1842–4. [f] Guyot.

determined (1) by the gravitation disturbance, from the mean of the thermometric extreme daily ranges (28.925), from the mean of the observed ranges on land and at sea (25.015), from the differences between the polar and equatorial mean temperatures according to Johnston (25.55), or Daguin (25.431), or from the annual range (31.04),—or (2) by the barometric disturbance, from the intersolstitial range (33.823), indicate an action on the atmosphere by the sun's radiating energy, which is more than twenty-five times as great as that which is due to simple solar attraction. The annual and intersolstitial ranges involve periods of such length that the differences of temperature may, perhaps, be more influenced by the earth's centrifugal force than by the mere difference of gravity. If the centrifugal force ($\frac{1}{194}$) is substituted for the difference of gravity

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TABLE II.—AVERAGE DAILY RANGE OF THE THERMOMETER.

Guyot's Table.	Station.	Lat.	Range.	Guyot's Table.	Station.	Lat.	Range.
		° ′	°			° ′	°
1	Washington, .	38 54	13.63	43	Prague, . . .	50 5	9.52
3	Philadelphia, .	39 58	12.34	44	" . . .	" "	8.62
5	Frankford, . .	39 57	14.29	45	Plymouth, . .	50 22	8.62
6	Toronto, . . .	43 40	11.53	47	Brussels, . . .	50 51	9.67
8	" . . .	" "	11.25	50	Mühlhausen, .	51 13	10.78
9	" . . .	" "	11.41	51	Utrecht, . . .	52 5	8.66
10	Montreal, . .	45 30	11.07	53	Greenwich, . .	51 29	10.19
11	Sitka, ...	57 3	7.31	54	" . .	" "	10.60
12	Boothia Felix, .	69 59	5.90	55	Halle, ...	51 30	11.20
16	Rio Janeiro,. .	22 54	5.85	56	Göttingen, . .	51 32	12.53
5'	Amherst, . . .	42 22	14.61	57	Berlin, . . .	52 30	10.24
18	Trevandrum, .	8 31	11.97	58	Salzuflen, . .	52 5	9.07
20	Madras, . . .	13 4	9.54	59	Stettin, . . .	53 25	9.61
22	Bombay, . . .	18 56	5.49	60	Apenrade, . .	55 3	8.73
25	" . . .	" "	9.70	61	Leith, ...	55 59	6.13
26	Calcutta, . . .	22 33	11.47	63	Makerstoun, .	55 36	9.31
27	Tiflis, ...	41 41	12.98	65	Catharinenburg,	56 50	11.34
28	Peking, . . .	39 54	14.98	66	"	" "	11.56
29	Nertchinsk, . .	51 18	15.41	67	St. Petersburg,.	59 56	7.29
31	Barnaul, . . .	53 20	14.13	68	Helsingfors, . .	60 10	7.29
33	" . . .	" "	15.46	69	St. Petersburg,.	59 56	7.96
34	Rome, ...	41 54	14.15	70	Helsingfors, . .	60 10	9.34
35	Padua, . . .	45 24	10.26	71	Christiania, . .	59 55	8.41
36	Geneva, . . .	46 12	11.72	72	Drontheim, . .	63 26	7.99
38	St. Bernard,. .	45 52	8.41	73	St. of Kara, . .	70 37	4.79
40	Kremsmünster,.	48 3	8 73	74	Nov. Zemlia, .	73	3.55
41	Salzburg,. . .	47 48	9.83	76	St. Helena, . .	15 55	5.56
42	Munich, . . .	48 9	12.53	77	C. of Good Hope,	33 56	9.61
				78	Hobarton, . .	42 53	12.35

($\frac{1}{150}$) in calculating the last two of the above ratios, they approximate more nearly to the other four ($31.04 \times \frac{1}{154} \div \frac{1}{150} = 24$; $33.823 \times \frac{1}{154} \div \frac{1}{150} = 26.17$).

The final ratios of the table show that the thermometric intersolstitial range bears nearly the same proportion to the daily land range, as the annual range of temperature bears to the temperature-variation which corresponds to the annual barometric range.

The observations at St. Bernard show a remarkable tabular correspondence, both in the parallelism between the daily temperature-variations and the cosines of the hour-angles (Table I), and in the approximation of the daily thermometric range (Table II) to the mean of the land and maritime ranges (Table V). The general average of Table I, viz.:

0°	15°	30°	45°	60°	75°
1.	.972	.888	.745	.543	.286

exhibits the greatest difference from the cosine ratios at the hour-angle of 75°, when the observed excess is $\frac{27}{259}$ or 10.4 per cent. The greatest local difference ($\frac{365-259}{259} = 40.92$ per cent.) is shown at Toronto, at the same hour-angle.

Many physicists have supposed that heat and attraction are but opposite phases of a single force, and the hydrodynamic researches

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TABLE III.—AVERAGE NORTH AMERICAN ANNUAL RANGE.

YEAR.	BAROMETER.			THERMOMETER.	
	No. of Obs.	Aggregate of Means.	Aggregate Range.	No. of Obs.	Aggregate Range.
					°
1854	53	1568.20	81.42	92	9159.0
1855	65	1923.50	105.71	101	10179.0
1856	71	2097.91	104.02	124	13136.1
1857	89	2632.32	146.92	153	16296.5
1858	103	3038.43	141.45	180	17193.5
1859	113	3319.29	170.11	190	19265.4
Total, . .	494	14579.65	749.63	840	85229.5
Average, . .	.	29.51	1.52	. . . .	101.5

$$\frac{\text{Av. Bar. Range}}{\text{Av. Bar. Height}} \times \frac{180°}{.367} = 25°.217$$

$$101°.5 \div 25°.217 = 4.024$$

of Challis, Rankine, and Helmholtz may be so interpreted as to corroborate such a hypothesis. I am not aware, however, that any one has hitherto attempted to verify the theory by observation, or to point out any path by which cosmical tests may be attainable.

I do not feel that the tests which I have here submitted are well-defined enough to warrant any present attempt at a complete mechanical interpretation of the ratios to which they lead. But in any future mathematical or empirical investigations on the subject, it may be well to keep in view the following propositions:

1. The motions of every particle of the earth's atmosphere are controlled, mainly, by the tendency to equilibrium between the solar and terrestrial attractions.

2. The undulations (of light, heat, etc.) which radiate from the surface of the solar photosphere, originate at a point where the sun's attractive energy is [$354936 \div (\frac{44}{3}\frac{100}{95}\frac{0}{8})^2 =$] 28.56 times as great as the earth's superficial attraction.

3. If two equal material particles are kept asunder by an inter-

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TABLE IV.—AVERAGE NORTH AMERICAN INTERSOLSTITIAL RANGE.

Year.	BAROMETER.				THERMOMETER.			
	January.		July.		January.		July.	
	No. of Obs.	Aggregate of Means.	No. of Obs.	Aggregate of Means.	No. of Obs.	Aggregate of Means.	No. of Obs.	Aggregate of Means.
1854	96	2839.64	90	2659.62	167	4792°.13	165	12763°.68
1855	94	2781.54	84	2482.51	163	5274 .50	148	11058 .97
1856	110	3252.21	115	3391.54	204	4148 .06	214	16167 .26
1857	138	4090.17	132	3891.22	263	5292 .25	248	18159 .83
1858	156	4605.17	151	4444.47	299	10932 .11	264	19744 .50
1859	162	4767.27	149	4372.35	281	8830 .58	268	20957 .50
Total,	756	22336.00	721	21241.71	1377	39269°.63	1307	98851°.74
Av. heights,	. 29.54		29.46		28.52		75.63	

$$\frac{\text{Av. Bar. Range}}{\text{Av. Bar. Height}} \times \frac{180°}{.367} = 1°.393$$

(Av. Ther. Range) $47°.115 \div 1°.393 = 33.823$

posed elastic medium, the attractive force of each particle, at the centre of elasticity, is four times as great as the mutual attraction of the particles for each other.

4. The velocity of light is nearly the same as the velocity which would be acquired in one year by a falling body, under the influence of an accelerating force equivalent to the force of gravitation at the earth's surface ($32\frac{1}{6} \times 86400 \times 365\frac{1}{4} \div 5280 = 192254$ miles per second). This is perhaps merely a curious accidental coincidence.

5. There is probably a daily flow of the expanded air, at noon, over the cooler and denser air, eastwardly and westwardly. Some physicists have thought that this overflow is sufficient to account for the daily barometric tides.

6. The $\left\{\begin{matrix}\text{momentum} \\ \text{moment of inertia}\end{matrix}\right\}$ of the atmosphere, in the direction of its orbital motion, is about $\left\{\begin{matrix}66 \\ 529000000\end{matrix}\right\}$ times as great as that which is due to the earth's daily rotation.

TABLE V.—RATIOS OF TEMPERATURE-VARIATIONS TO VARIATIONS IN GRAVITY OR SPECIFIC GRAVITY.

Observed Averages.		Divisor.	Ratio.
Lowest Daily Range, T. II, ...	3°.55	0°.3286[a]	10.803
Highest " " "	15 .46	0 .3286	47.048
Mean, "	9 .50	0 .3286	28.925
Daily Land Range, "	10 .86	0 .3286	33.049
" Maritime Range, "	5 .58	0 .3286	16.981
Mean, "	8 .22	0 .3286	25.015
Polar-Equatorial Diff. J., ...	83 .55	3 .27[b]	25.55
" " " D., ...	83 .16	3 .27	25.431
Annual Range, T. III, ...	101 .5	3 .27	31.04
Intersolstitial Range, T. IV, ...	47 .115	1 .393[c]	33.823
" " " "	47 .115	10 .86[d]	4.338
Annual Range, T. III, ...	101 .5	25 .217[e]	4.025

[a] Variation of temperature corresponding to the variation of atmospheric volume which is due to solar attraction.

[b] Temperature-variation corresponding to the difference between the polar and equatorial attractions

[c] Temperature-variation corresponding to the barometric intersolstitial variation.

[d] Average daily land range of temperature.

[e] Temperature-variation corresponding to barometric annual range.

Prof. Cresson communicated a note upon a copper coin in the possession of Mr. M. Moore, of Trenton Falls, dated July 24th, 1866, viz.:

There came into my hands last week, a small copper coin of the weight of forty-two grains, in fine condition, very much like in appearance to the quarter-eagle of 1798, figured in Dickeson's Manual. Around the head of Liberty, is twelve stars, on the right of the date 1803, is in very minute letters the word KETTLE, two stars being displaced for its insertion; the word Liberty is not directly over the head, but on the right. I think it a trial piece of the quarter eagle of 1803.

Mr. Jacob R. Telfair, of the city of New York gave it to me; his little son had found it in his father's garden at Washington Heights near New York.

Mr. Lesley communicated extracts from a letter to him from Mr. William Köhler, dated Austinville, Wythe County, Va., June 12th, 1866, as follows:

Some years ago in your report of the Lead Ores at this mine, you wrote that they are found in an anticlinal formation, which, however, was not easy to make out. This we have verified in the last few years, by driving a new tunnel from the northeastern end of the hill (from the flat on the river) southwestward, striking the ore and going through it. We then had a rock pitching towards us and a lead of ore on each side. That on the left dipping southeast, and that on the right northwest. We first drove on the lead dipping southeast; we left the ore standing over us. Then also the lead dipping northwest. Both continue after driving for several hundred feet on them. Taking out the mass of ore over these drifts we found that they connected above. We left open a gangway *over the anticlinal axis* from the southeast dipping lead to the northwest. I thought it would be gratifying to you, to know this, as your views were quite the contrary of the Professors Rogers, who thought we had regular veins (thrown up from below) there. I am, etc.,

WM. KÖHLER.

Prof. Cresson described the appearance of curious lunar rings observed by him at Pottsville and other places on the 27th July, 1866.

Pending nominations Nos. 550 to 555, and new nomination 556, were read.

And the Society was adjourned.

Stated Meeting, October 5, 1866.

Present, thirteen members.

Dr. Wood, President, in the Chair.

Letters acknowledging the receipt of the publications from the Linnæan Society and the Geological Society, of London, were read.

Donations for the Library were received from the following societies and authors: The Dutch Geological of Berlin, Royal Geographical of Paris, Linnæan of London, Zoological of London, Bath and West of England, and Boston Natural History Societies; also of the Academies, the Royal Prussian of Berlin, the Royal Mining of Loeben and Schemnitz, and Natural Sciences of Philadelphia; the Dublin Quarterly Journal, from Prof. Suringer, Richard Owen, and three circulars relating to the Paris Exposition.

The Committee to whom was referred Prof. H. C. Wood's article entitled "A Contribution to the Knowledge of the Flora of the Coal Period in the United States," reported in favor of its publication in the Transactions, which was ordered accordingly.

Pending nominations Nos. 550 to 556 inclusive were read.

Mr. Eli K. Price, on the part of the Board, Officers, and Council of the Society, made a report, embracing a preamble and resolutions, which were adopted, in substance as follows:

Whereas it is expedient, for the security of the books and property of this Society, that there should be erected a fire-proof building; and whereas it is probable, if the purpose of erecting such a building were resolved upon, that donations and bequests would be made, and a fund created which, by accumulation, would be adequate to the desired object.

The resolutions provide for the appointment of five Trustees to receive the donations and bequests, and make investments, and in case such occur in real estate, stocks or loans, they shall hold the same under the direction of the donors, or

if not instructed, at their discretion, for the benefit of the trust fund.

That the Trustees shall elect from their number a Chairman and a Treasurer, and shall meet upon the call of the Chairman, and a majority of the whole shall be competent to act; and minutes shall be kept, subject to the inspection of the President or Board of Officers of the Society. They shall render an account of the condition of the trust whenever required by the Society, and submit a statement at the first meeting in December of each year.

That the investments shall be made in the name of all the Trustees in trust for the building fund of the Society. And that no one of the Trustees shall ever use any part of the trust fund in his own account. That the Trustees shall not be required to give security or be liable for loss, except by malfeasance; nor be allowed compensation for services.

They also provide that whenever vacancies occur and the number be reduced to two, the Society shall, at its first stated meeting in January, appoint Trustees to fill the vacancies and restore the original number; and in case of inability of any Trustee to perform his duties or a disagreement among them, the Society shall decide between them, and may accept resignations and appoint others in their places.

And that all moneys received for the construction of a fireproof building shall be paid over to the Treasurer.

And that the Trustees shall be Dr. George B. Wood, Eli K. Price, Frederick Fraley, Dr. Isaac Hays, and Benjamin V. Marsh.

The declaration and covenant of Trustees was submitted and adopted.

On motion, it was ordered that the moneys received for the mortgage held by the Society on coal lands in Northumberland County be appropriated to the fund for the erection of a fireproof building for the Society.

And the Society was adjourned.

Stated Meeting, October 19, 1866.

Present, eleven members.

Vice-President Judge SHARSWOOD in the Chair.

A letter was read from the Bureau of Statistics, Washington, asking information with regard to the number and character of the volumes in the Society's Library. Also an acceptance from Mr. Peale of the appointment to prepare an obituary notice of the late M. W. Baldwin.

Donations for the Library were received as follows: From the Royal Prussian Academy of Sciences, Paris Geographical Society, the Academy of Natural Sciences of Philadelphia, the American Institute of the City of New York, the Journal of Medical Sciences, an Address by Prof. Horsford, the Medical News and Library, Dr. Coates A sketch of efforts to civilize the Indians by the Society of Friends, and from Trübner & Co. Dr. Metterrutzner's treatise on the Dinka language, Julg's Kalmükische Märchen, Dr. Ginsburg's Kabbalah, and Tourner's account of the tooth relic of Ceylon.

A paper, entitled "A Synopsis of the Cyprinidæ of Pennsylvania," by Prof. E. D. Cope, offered for publication in the Transactions, was referred to a Committee, consisting of Drs. Bridges, Ruschenberger, and Leidy.

Pending nominations Nos. 550 to 556 inclusive, and new nomination No. 557, were read, and nominations Nos. 552, 553, and 554, were postponed for a future ballot.

The Society then proceeded to ballot for candidates for membership.

The ballot-boxes were opened and the following named gentlemen were declared duly elected members of the Society:

Dr. William P. Schimper, Strasbourg, France.

Dr. Robert J. Breckenridge, Danville, Kentucky.

Dr. Jeffries Wyman, Cambridge, Mass.

Dr. Jacob M. Da Costa, Philadelphia.

And the Society was adjourned.

Stated Meeting, November 2, 1866.

Present, eleven members.

Vice-President Prof. CRESSON in the Chair.

Letters were read from Jeffries Wyman, dated Cambridge, Mass., October 25; from J. M. Da Costa, dated Philadelphia, October 26, and from R. J. Breckenridge, dated Danville, Ky., October 27, severally acknowledging the receipt of the notice of their election as members. Also from J. C. Adams, Cambridge Observatory, England, inclosing his photographic likeness, and requesting to be supplied with missing numbers of the Society's Proceedings; and from J. E. Hilgard, dated Washington, D. C., October, 1866, announcing the transmission of the first volume of the Memoirs of the National Academy of Sciences.

Donations for the Library were announced as received from various sources, as follows: Treatise entitled "La Sarcine de l'Estomac," by Prof. Suringar; Transactions of the Zoological Society of London; The Philosophical Magazine and Journal, London; Transactions of the Connecticut Academy of Arts and Sciences; Memoir of T. E. Blackwell; Memoirs of the National Academy of Sciences; Journal of the Franklin Institute, and Medical News and Library.

Judge Sharswood was excused from preparing an obituary notice of the late Judge Taney.

Dr. Hayden made some remarks on a short visit to the celebrated Pipestone Quarry, and exhibited some specimens of the rock, as well as some pipes and other ornaments that had been made from the rock with a turning lathe. The Northwest Fur Company have manufactured nearly two thousand pipes within the past two years, and traded them to the Indians on the Upper Missouri. This fact will throw a suspicion on the genuineness of Indian pipes in the future.

Dr. H. stated that the locality where the pipestone is found is situated at the head of Pipestone Creek, a small tributary of the Big

Sioux River. It is about 130 miles north of Sioux City. The place would hardly be noticed by any one who was not acquainted with the celebrity of the Pipestone. It is located in a small ravine, with not a tree or scarcely a bush to greet the eye. The Pipestone layer rests upon a bed of gray quartzite, and is overlaid by about five feet of the same rock. The Pipestone bed is about eleven inches in thickness, but only about two and a quarter inches in thickness are wrought into pipes. The remainder is too brittle or impure for use. Above the gray quartzite is a vertical wall, about thirty feet, of variegated quartzites, over which flows Pipestone Creek, a stream of pure, clear water, forming a beautiful cascade.

Dr. H. remarked that he did not think this locality had been known to the Indians for a long period in the past. He had examined with considerable care the books treating of the ancient mounds of the Mississippi Valley, and he could find no trace of this rock among all the implements and ornaments that had been found there. Not a stone implement has ever been found in the vicinity of the quarry; and he infers from this fact that it could not have been known during the stone age.

At Sioux Falls, on the Big Sioux River, there is a fine exhibition of the variegated quartzites. There is a series of falls, six in number, with an aggregate descent of one hundred and ten feet, forming the finest water-power yet observed in the West.

The rocks at Sioux Falls and Pipestone Quarry are evidently of the same age, geologically, and by their apparently metamorphic character, lead the mind to the Azoic series. It is the opinion of Prof. Hall, who made an extensive exploration in this region, that they are of Huronian age. Some obscure casts of what appear to be bivalve shells, at Sioux Falls, direct the attention to the newer fossiliferous rocks, Triassic possibly.

Mr. Peale exhibited specimens of "Nidularia fascicularis," a fungus found near the Delaware Water Gap, growing upon the branches of decaying wood.

Pending nominations Nos. 552, 553, 554, and 557 were read.

The Committee to which was referred a paper, by Prof. Cope, entitled "Synopsis of the Cyprinidæ of Pennsylvania," reported in favor of its publication in the Transactions, which was ordered accordingly.

The Committee of Finance offered a resolution, which was adopted, providing for the payment of a bill for the expenses of printing, etc., of two hundred and fifty copies of the second part of the Catalogue of the Library.

On motion of Mr. Fraley, the presiding officer was empowered to appoint, *ad interim*, a Committee of seven members to aid the Trustees of the building fund for the erection of a fire-proof building, in obtaining subscriptions thereto.

And the Society was adjourned.

Stated Meeting, November 16, 1866.

Present, twenty-five members.

Judge SHARSWOOD, Vice-President, in the Chair.

Dr. Jacob M. Da Costa, a recently elected member, was introduced and took his seat.

Letters were read from the Royal Society of London, dated August 27, 1866; from the Secretary of the Smithsonian Institute, dated July 19, December 28, 1865, and January 27, 1866, severally acknowledging the receipt of publications of the Society. Also from the Librarian of the Historical Society of Pennsylvania, asking permission for that Society to copy and publish the manuscript "Logan Papers," now in possession of the Society.

A letter from William B. Reed, dated November, 1866, was read, resigning his membership in the Society; which resignation was accepted.

A photograph likeness of Dr. Hugh L. Hodge was presented for the Album.

Donations for the Library were announced as follows: From the Imperial Academy of Sciences, St. Petersburg; from the Royal Astronomical and the Royal Societies of London; from the Stonyhurst College Observatory; from the Kew Observatory; from M. Sartorius, his notice of Studer's

Epochs, and from John Biddle, a volume of almanacs published in Philadelphia, by Jacob Taylor, embracing fifteen of the years from 1705 to 1744.

Dr. Hayden made some remarks in regard to an extensive chalk deposit on the Missouri River.

It commences about one hundred miles above Omaha City, and extends to the Great Bend of the Missouri, covering an area of four hundred miles in length and about two hundred in breadth, with an aggregate thickness of one thousand feet or more. The lower part is a somewhat compact gray limestone, and is used by the settlers for building purposes and for burning into lime. The upper portion is a soft, rust-yellow chalk, which, though more impure, very much resembles our chalk of commerce, and could be used for similar economical purposes. It is composed of magnesia, alumina, and a large proportion of carbonate of lime. The coloring matter is the sesquioxide of iron. It is believed that when these beds are more carefully studied, they will be found to be the American representatives of the true chalk-beds of Europe. Hitherto it has not been admitted by geologists that any true chalk deposits existed in America, and all of our chalk of commerce comes from Europe. It is believed that in case of any rupture of our peaceful relations with the Old World, these chalk deposits will become of great economical value. They would also become useful, if needed, as a fertilizer.

Dr. H. also exhibited a number of fossils from this formation, found near Yankton, the capital of Dakota Territory. There were specimens of oysters, very small (Ostrea congesta, Conrad), which are crowded together in vast quantities in many localities. There were also several species of Inoceramus. But the most remarkable organic remains were those of fishes, which are all undescribed as yet. One species is closely allied to our mackerel, and all of these seem to be very similar to those now found in our salt waters. In the lower gray chalk were some impressions which appear to be those of sea-weeds.

These remarks are made merely to call the attention of scientific men to these wonderful chalk deposits in the Far West.

The minutes of the Board of Officers and Council, at their last meeting, were read.

Pending nominations Nos. 552, 553, 554, and 557, and new nominations, Nos. 558 and 559, were read.

The Committee to aid in obtaining subscriptions to the Society's building fund were announced to be S. V. Merrick, Joseph Harrison, William Sellers, Franklin Peale, Henry Winsor, S. W. Roberts, and Robert Cornelius.

On motion of Mr. Fraley, permission was granted to the Historical Society of Pennsylvania to copy and publish the Logan manuscripts, in the possession of this Society, provided the copying be done in the Hall, under the supervision of the Secretaries of the Society.

The proposition of the Board of Officers and Council to offer a premium "for the best invention for utilizing Anthracite coal dust," was considered, and the following resolution was offered by Mr. Fraley, and adopted:

"*Resolved*, That the Board of Officers and Council be authorized to offer a premium of Five Hundred Dollars for any successful process by which the Anthracite coal-dust may be economically utilized. Such premium to be competed for and awarded in such manner as the Board of Officers and Council may designate; and the premium, if awarded, to be paid out of the accumulated income of the Magellanic Premium Fund."

Mr. Marsh called the attention of the Society to some display of meteors on the night of the 13th inst., that had been seen at New Haven, and asked whether they had been observed by any one in this city. He described the path and appearance of the meteors.

And the Society was adjourned.

Stated Meeting, December 7, 1866.

Present, twenty-three members.

Dr. Wood, President, in the Chair.

Letters were read from the Society of Antiquaries of London, November 16; from Harvard College, December 3; from the New York Historical Society, December 3, and the Vaudois Society of Natural Sciences, February 27, 1866, ac-

knowledging the receipt of the publications of the Society, and from the Vaudois Society, stating deficiencies of the Proceedings. Also a communication from the Imperial Geological Society of St. Petersburg, October 26, 1866, inviting scientific gentlemen and friends to the celebration of their fiftieth anniversary on the 7th January next.

Donations for the Library were announced from the Royal Prussian Academy of Science; from the Societies of Natural Sciences of Vaudois, of the Geographical of Paris, of the Royal Astronomical of London, and of the New Hampshire Historical; from the British Association for the Advancement of Science; from the Public Library of Boston, the American Journal of Sciences; from the Franklin Institute; from Carl Schinz, of Strasbourg; from Dr. George B. Wood, of Philadelphia, and the Director of the United States Mint.

Pursuant to appointment, Mr. Peale read an obituary notice of the late Matthias W. Baldwin, a deceased member of the Society, viz.:

The life of a man like that of the subject of this notice, furnishes a vast amount of matter, and exemplifies the results of character, habits, and principles that are most useful, in their influences, on all classes of society, and in all the relations of life; but the usages of this Society do not authorize details, however desirable upon other accounts, or however interesting to the immediate relatives of the departed. A just record of the life and character of the deceased is all that is aimed at in this Memorial.

On the tenth day of December, 1795, in Elizabethtown, New Jersey, Matthias William Baldwin was born. Much the largest proportion of his life was passed in the City of Philadelphia, in the vicinity of which, at his country seat, Wissinoming, he died, on the evening of October 7th, 1866, in the seventy-first year of his age.

He was the son of William Baldwin, and an exemplary mother, whose influence on his future life was all that could be desired, in moral and religious example and precept.

He had the misfortune to lose the first, in early childhood, but the judicous training and industrious energy of the last, so far supplied the loss, that no serious privation followed in the rearing of a family of five children, two of whom survive at this time.

His father was in life successful in a mechanical profession, and realized property, which was subsequently lost, thus calling forth the energy of his mother, as previously noticed; it is, therefore obvious, how the mechanical tendencies of the subject of this notice, had their origin; and accordingly, the occupations and amusements of the boyhood of Matthias, were mechanical, in which he indulged, as far as time and limited means permitted.

His education, under such circumstances, was necessarily confined to the ordinary acquirements of elementary instruction, which after-studies, and associations, much improved and enlarged.

The profession chosen for him, to which he was apprenticed, was that of jeweller, in the obligations of which, he was faithfully occupied during the five years of his minority, in Frankford, Pennsylvania.

After this he was employed in the establishment of Fletcher & Gardener, in this city, extensive manufacturers and dealers in jewelry and plate. The first named being subsequently one of the officers of the Franklin Institute, in which Institution Mr. Baldwin exercised an active and influential part, as will be noticed hereafter.

Mr. Baldwin commenced business on his own account in 1819, probably in partnership with Mr. Colton, in the manufacture of jewelry, and appears to have been successful for a limited time only, as he subsequently changed his business to the manufacture of book-binders' tools, calico-printers rolls, &c., in which he became associated with Mr. David Mason. In this business the enlarged views of Mr. Baldwin and his careful manipulation, were eminently important, and the results such, as usually accompany skilled, practical ability. Thus associated a manufactory was established, beginning in the year 1825, that rendered the country independent of foreign supply. It was situated in a small street, running north from Walnut Street, above Fourth Street, in this city. It was in this place that the author of this memoir made the acquaintance of Mr. Baldwin, which afterwards ripened into an intimacy, that continued in uninterrupted harmony to the end of his life.

The success of the firm in the departments just noticed, and the increase of business arising from it, induced a change of locality to a larger space, and increased power; it was effected by removal to Minor Street near Sixth, in the latter part of 1827 or beginning of 1828, and it was here that the dawn of his prosperity had its rise, to shine forth a bright and glorious noon, of utility and success.

It was in this workshop that Mr. Baldwin made the designs for, and built his first steam engine, intended to supply the motive power

demanded by his enlarged business. It was of novel construction, in several respects, and was finished to an extent entirely unexampled in that day. Its vertical cylinder, so placed for economy of space; its forked cross-head, and pitman, guides at the sides of the cylinder, were novelties, in the disposition, and form of parts, and its bevel wheels, which gave motion to the governor, were without teeth, doing their duty by friction alone, being noiseless, like the beautiful engine whose motion that governor controlled.

This little engine of five horse power was the object of much attention among machinists, and excited general admiration by its quiet, though efficient motion, and the fine finish of all its parts. It is at this hour an efficient motive power in the great establishment of M. W. Baldwin & Co., with very slight changes in its parts, a durable evidence of the sound mechanical judgment of him, who designed and executed it.

It was about this time that the attention of the world was concentrated on the importance of railroads, for transportation, and the means of moving upon them. The history of the Locomotive is well known, and need not be recapitulated, but the experience in this country was very limited, although the public mind and curiosity were ardently drawn towards all that had been done, or was doing in relation thereto. It was in consequence of the feeling on this important matter that Mr. Baldwin was requested by the author of this memoir to make for the Philadelphia Museum, of which he was manager, a model locomotive. After the examination of all the resources then available in description, and sketches of the engines, which had competed for the premium on the Liverpool and Manchester Railroad, a plan was adopted, and the model engine commenced in 1830, and after a few experiments and modifications, finished in 1831. And on the 25th of April of that year was put in operation on a track laid in the rooms of the Museum, in the Arcade, making the circuit of the whole suite, and drawing two miniature cars, containing seats for four passengers (which were sometimes loaded double), in a manner highly gratifying to the public, who attended in crowds to witness, for the first time in this city and state, the effect of steam in railroad transportation.

It may be proper to observe, that the efficiency of this miniature engine, and its satisfactory performance, were mainly due to the discharge of the exhaust, or waste steam, into the stack, or chimney; a principle of vital importance in all engines, rendering a blowing apparatus unnecessary, and supplying the fuel with air requisite for

combustion, without the sacrifice of power for that object; a principle then new, or little known in this connection. To whom the invention (if it can be so called) is due, who at this time can tell? The fuel used in the small fire-space of the boiler of this model was pine-knot coal, although anthracite was partially successful in its application, the difficulty in the use of any fuel, being the diminutive space above alluded to.

It may be permitted also, in this connection, to observe that the first published observations upon the foaming of water in boilers, were made in the use of this model. They may be found in one of the newspapers of the day.

The attention of machinists was drawn to the subject of locomotion with considerable energy about this time. It was one of the great movements of the epoch; it demanded and received the attention the necessities of commerce and general intercourse required. Mr. Baldwin, as it may be naturally inferred, shared in the general excitement, and was therefore prepared to undertake the task, when an order came in 1832 from the Philadelphia and Germantown Railroad Company for the construction of a locomotive for that Company's road.

The only examples, or information, previous to this time of the construction of the now perfected locomotive engine, were the crude efforts of the previous years, and the various published and imperfect accounts and illustrations in the journals of the day.

Mr. Baldwin and the writer inspected the detached parts of a locomotive imported by the Camden and Amboy Railroad Company, in a shed on their road near Bordentown (at least such is the recollection of the place), and under some difficulty succeeded in making such observations and a few measurements, as were thought would be of service. It was with these slender means of observation, and the limited experience of the preceding model, that the task was undertaken, and the execution of the order commenced. It is but justice to add, that it was accompanied by restrictions as to weight, that are now at variance with all the principles that are desired, in fact govern, the use of motive power on railroads.

The building of this engine was carried on under the difficulties of few and insufficient tools and space, and completed in about six months. Begun in Minor Street, it was finished, in 1832, in the new and larger space in Lodge Alley, to which the shop had been removed, and was placed upon the road on the 23d of November in that year.

The experiments which were immediately made with the "Iron-

sides," as this engine was called, in speed and management were eminently successful. The writer and other friends, scientific and mechanic, made short excursions on the road, realizing the sensations that only occur once in a generation, under the novel circumstances afforded by, as in this case, the flight through the air at the rate of fifty or sixty miles an hour.

Difficulties arose in the settlement of his account with the officers of the Company, who appear to have expected that this engine would do what their own restrictions had rendered impossible, and there were other difficulties that had their origin in the grading and construction of the road itself.

These facts are amusingly illustrated by one of the advertisements of the Company, which was in the following words:

"NOTICE.—The engine (built by Mr. Baldwin) with a train of cars, will run daily (commencing this day) when the weather is fair, as follows," &c. . . . "*When the weather is not fair*, the horses will draw the cars the four trips."

No one need be told now that when the rails are wet there is less adhesion than at other times, and as the grades were steep, it is not surprising that one of the lightest engines ever built, was unable to draw all the cars, and all the crowd that panted for a trip by steam. The parties who indulged such unreasonable desires, could not have exercised common reason in expecting from the motive power more than was witnessed by the writer, the slipping of the wheels under a full head of steam.

The sand-box, now an indispensable adjunct of every locomotive, was then unknown; had it been, it would most likely have supplied the means of adhesion, something better than the horses' feet, advertised to guarantee the trip.

This little engine was an undoubted success, and subsequently, when fairly and skilfully run on the road properly adjusted and secured, gave entire satisfaction to the public, and all parties concerned.

The removal to enlarged premises in Lodge Alley, gave facilities that soon told upon his reputation, and augmented his business; in this place his second engine was made, and successive numbers undertaken. Further increase of business rendered another removal necessary; in 1835, the property at the corner of Broad and Hamilton Streets was purchased, and here the regular manufacture of Locomotives, on an enlarged scale, was established, and became the principal occupation, although it did not exclude other business, as evidenced

by the construction of the engine for the City Ice Boat, whose efficient services in clearing the channel of the Delaware, as well as her employment by Government during the late rebellion, are well known to the whole community.

It is not necessary to enumerate the various improvements made by Mr. Baldwin, in the parts, construction, and manufacture of Locomotives; it would be a lengthy enumeration. It is sufficient to say, that the results are seen on all the railroads of the country, in the presence of engines adapted to all the purposes of draught and speed. But a passing remark, reverting to past history, upon the fact of ascending the inclined plane at Belmont, and manœuvring upon it, was one of the feats of that early date, exciting surprise in the minds of all, whether natural philosopher, mechanician, or ordinary observer. Since that day, the mountain heights of our coal fields, even the Alleghany ridge itself, seem to offer scarcely any impediment, either to the ponderous engine, or its cumbrous train of freight. Much of this success in transportation is due to the form and adaptation of the best freight engines, which have had their origin in the magnificent establishment of M. W. Baldwin & Co., in this city.

It must not be supposed that the career thus imperfectly sketched, was an uninterrupted course of prosperity; on the contrary, it was attended by financial, and other embarassments, that at times, were nearly fatal in their effects; but it is equally true that Mr. Baldwin's confidence in his own ability, and the line that he was pursuing, never failed, and it is well known that his integrity, appreciated and regarded as it was, kept and sustained him through all the convulsions of those days, and ultimately crowned his success with the halo of honor, under which he met and extinguished every debt, both principal and interest.

Terms of partnership were agreed upon, between Mr. Baldwin and Mr. Matthew Baird, on the 26th of March, 1853, which went into operation on the 1st of January, 1854, since which time the establishment has been developed, and extended on a scale that may justly be termed magnificent.

It might reasonably be supposed, that with such a weight of responsibilities, Mr. Baldwin was fully occupied with the conduct of his Factory; he found time nevertheless, to take a full share of the duties of a member and officer of the Franklin Institute of this State. He was one of the original members, participating in the proceedings of March the 20th, 1824; was placed on the Committee of Science

and Arts in 1834; elected Vice-President in 1855, and so remaining until 1863.

In the examination of machines and inventions presented to the judgment of the Institute, he was always distinguished for the sound views he took of principles, and keen insight of the merit of the article presented, and candid and independent in his opinions and statements in relation thereto.

He had the honor of election to the American Philosophical Society, on the 18th of January, 1833, and was often present at its meetings, though rarely taking an active part in its proceedings.

The Horticultural Society of this city, was a favorite Institution; he contributed largely to the attractiveness of the Meetings, by a liberal display of the beauties of his conservatory, and presided over its affairs for a number of years. He was elected a member, March 18th, 1851, and was elevated to the Presidency, January 19th, 1858, in which office he continued until 1863.

The resolutions which were adopted by the members, on the announcement of his decease, were of the most grateful, appreciative, and regretful character.

A peculiar fondness for foliage in color and form, was one of his characteristic traits, at least such a deduction may justly be drawn, from the number and variety of the strange though beautiful leaves of plants, which his conservatories contained.

Mr. Baldwin was also a member of the Board of Directors of the Pennsylvania Academy of the Fine Arts. Elected to that body in the year 1852. The appreciation of his associates in the Direction of that Institution, is demonstrated by the resolutions adopted by them on the announcement of his separation from their Association.

Mr. Baldwin became a member of the Musical Fund Society, founded for the support of decayed Musicians and the promotion of the art, although the increase of population, and the consequent resources of the musical portion of the community have long since rendered the second object of the Corporation (in which it had been eminently successful), no longer a necessity; yet Mr. Baldwin, while health permitted, never failed to give his presence and countenance to the duties of the first object, and the obligations of the committees on which he was placed. He became an amateur member, April 27th, 1847, and a life member, October 6th, 1852, after being elected one of the Managers of the Fund, at its annual meeting, May 4th, 1852.

His services in this charity, may be summed up thus: on the

Committee of the Fund, one year; on the Committee of Relief, four years; on the Committee of Admission, ten years, or to the end of his days.

The share which Mr. Baldwin exercised in the political movements of the day, though limited in extent, were of much importance; he fulfilled the duties which they imposed upon him with his usual zeal and independence. As a member of the Convention to amend the Constitution of the State of Pennsylvania in 1837, he took, in that body, a decided stand, on points that have become vital principles in the general progress or advance of the human race, and always on the side of liberality and justice.

Elected a member of the State Legislature, in 1853, he was distinguished, amid the mazes of diplomacy, during his term of service in the winter of 1854, for his straightforward and consistent course in that line of conscientiousness which had marked his life.

As an Inspector of the County Prison, Mr. Baldwin may be cited as an example of persevering benevolence in an ungrateful task, marked by all the disagreeable and revolting feelings which accompany contact with the vile, the miserable, and the degraded. In this office his sense of justice, and hatred of intemperance and vice in all its motley garb, must have been sorely tried, but mercy and benevolence seem to have been the prevailing sentiments which governed him in the treatment of the unfortunate and vicious, with whom he came in contact in his inspection tours of duty.

It will be observed in the record of his career, as thus traced, that Mr. Baldwin was remarkable for the number and variety of the occupations and pursuits to which he devoted his working and his leisure hours; to do full justice to his character would require much more extended remarks (pleasant labor it is true), but not required by the objects of this notice.

His principal characteristic was the fervent religious bias of his mind; from early life it appears to have impressed him with its vital importance, and to have influenced him, more or less, in all the transactions of his career: it developed itself most forcibly, in the aid which he gave to the formation of religious associations, and the building and support of churches, for that particular denomination to which he was attached; becoming more marked as he advanced in age, and as his means accumulated; so that his own revenue, great as it had become within the last few years of his business career, appears to have been almost absorbed in this direction.

That he was fond of everything beautiful in nature, is demonstra-

ted by the flowers, the trees, and plants of his favorite residence at Wissinoming, which he had embellished to the utmost, in the fruits of the tropics, the vines and esculents of the most liberal horticulture, and all that constitute the surroundings of a refined life in the country. But his fondness was not confined to the vegetable kingdom alone; it led to the collection and guardianship of a variety of animals. The deer and other ruminants had their comfortable parks. The smaller animals their appropriate shelter, and every variety of bird, its home and sustenance; and some too, were the pets of his lap, and seemed both the amusement and indulgence of a caressing habit of life.

His fondness for the fine arts, was one of his characteristics; his houses and rooms were filled to their utmost capacity with the pictures which he paid for liberally and justly, but none of that extravagant ostentation in purchase prices, which has been the wonder of latter days, had any footing in his well-selected collection. In this respect at least, his discrimination cannot be impeached.

The memorial of a man like this, might well be a eulogy, but it may be also treated by a friend, impartially, and in full justice without that extravagant praise which is so usual on such occasions. He was eminently social in his feelings and habits, at the same time, his principal characteristic was self-reliance; his own views, habits, and impulses, were those that he followed. That his views on temperance were philanthropic, no one can doubt, but like all others holding ultra opinions, he found by experience that the laws of matter (by the ordination of Providence for its own wise purposes), cannot be resisted, and that fermentation and its products were intended by the Supreme Ruler, not for the abuse, but for the good of man.

His earnest endeavors to resist the fermentation of his abundant crop of grapes were of no avail, and the value of the products in medicine, suited to his own case, was ultimately recognized and admitted.

He was not a sportsman in any sense of the word, but it is equally true that he never appeared better pleased, than when mounted on a fast horse, and sometimes an observant friend might see if he looked sharply, that to let any ambitious roadster pass him, was not usual, if possible. Neither can it be said that he was a gymnast, yet he habitually exercised his muscular system (recognizing its importance in hygiene) and contended with no little fervor for successful honors in that line; this was well known to his associates in the practice of archery.

His constitution was not robust; he suffered much from ill health at various periods of his life, the last years of which, were years of suffering, more or less, but it never changed his kindly feelings towards his friends, family, or the dumb pets of his household, especially did it never relax his energy in the great and complex business of his firm, or the more important charities of his heart and purse.

Too much praise cannot be bestowed on the final disposition of his worldly affairs; he did all that he intended to do in charity and benevolence during life, and left to his heirs a bright example for their guidance. In this respect so different from the ostentatious wording of those testamentary dispositions, that are now wasting their ample provisions in political jugglery, or turned aside by mismanagement to some other object, perhaps more objectionable.

His large property has been bequeathed, after provision for two surviving sisters, to and among his widow, two daughters, and an adopted daughter, in the latter, exemplifying that sentiment of justice and affection, that was so characteristic of him all through life.

Prof. Kendall read the following communication from Mr. George Davidson, of the United States Coast Survey, viz.:

A New Level for the Measurement of the Inclination of the Transit Axis of Portable Transit Instruments, for all Altitudes beyond the Reach of the Ordinary Striding Level.

The anomalous condition has heretofore existed that all stars best situated for obtaining time from meridian observations (except in extreme high latitudes) were really observed upon with hesitancy and doubt, because the striding level could not measure the inclination of the transit axis, and the inequalities and irregularities of the pivots, when the telescope pointed to a greater altitude than 55°. Between this altitude and the zenith all errors of inclination were necessarily assumed the same.

In combining zenith stars with quick-moving stars, the errors of level enter largely in giving erroneous values of azimuth and collimation: no reliance can be placed upon the value of the collimation error derived from reversals between sets of zenith stars observed to avoid unknown azimuthal errors; and the irregularity of the value of the collimation error derived from reversals upon different circumpolar stars, beyond the reach of the level, must frequently be attrib-

uted to undetermined errors of inclination arising from unknown inequalities and irregularities of the pivots.

In 1859, at the Coast Survey Station "Sulphur Peak," California (3471 feet above the ocean), the transit telescope exhibited such constant irregularity of clock errors with certain stars beyond the use of the level, that no confidence could be placed in the results, and I then devised this level for overcoming the difficulty.

The general idea of the frame of this level is that of three sides of a rectangle, lying in a horizontal plane, having the two shorter sides resting at right angles upon the transit axis pivots, with the long side carrying the level-tube parallel to the transit axis, and far enough in front of the telescope not to be touched by the transit axis. This, of course, presupposes the parts of the shorter sides or arms beyond the pivots to be heavy enough to counterpoise the parts in front. Upon the long side or cylinder in front the level-tube is secured with all the usual means of adjustment in the strider.

This level will be heavier than the ordinary level, which weighs eight pounds in the forty-two inch portable transits of the Coast Survey. Composed of the same material, it is estimated to weigh about fifteen pounds, but if made of aluminum-bronze, the weight will be slightly reduced with the parts of the same proportions. On account of the superior qualities of the bronze, the parts may be made lighter.

To reduce the chances of injury to the pivots by this level, as well as by the strider, I use a long, thin, flat spring, secured to the outer or inner side of each short arm, in a horizontal plane with the top of the pivot when in position, with one end secured and the other controlled by a set screw. When the level is placed on the pivots, the middle of the length of each spring rests upon the outer or inner part of its respective pivot, not bearing upon the supporting Y's; relieves the wearing parts of the pivots from the full weight of the level Y's, and protects them, in a measure, from the full force of all sharp blows. If the level were allowed to remain in position upon the pivots whilst the telescope was revolved for different altitudes, the increased weight would wear the pivots seriously in the supporting Y's, as the portable transits have no counterpoises. To obviate this, and also the ordinary wear of the pivots, a similar application of the spring could be introduced below the pivots, to relieve their pressure from the supporting Y's. This I proposed to the Superintendent of the Coast Survey, about ten years ago. With the twenty-five pounds weight of the present transit telescopes, the pivots rapidly and badly

wear, on account of the erroneous construction of the Y's and the tangential contact of the pivots with them.

To prevent torsion between the shorter arms and the level cylinder, triangular stay-pieces are introduced at each right angle of the joining; and for increased security, they may be introduced upon the upper or under sides.

This level, with the level-tube and supporting cylinder, and adjustments of the same size as the present striding level, permits measurements for the determination of the inclination of the transit axis, and for the inequalities and irregularities of the pivots, through a range of 45° on each side of the zenith. Of this arc, 70° have not heretofore been reached for these corrections, except in part by reflection observations, which are, however, practically excluded from use with the portable instruments and in the temporary observatories of the Coast Survey; and especially on trips for difference of longitude by chronometers, when the instruments are frequently set up hurriedly for a few hours only at each station.

GEORGE DAVIDSON.

The attention of the Society being directed to the subject of the expected meteoric display on the 13th or 14th ultimo, several members spoke on the subject, and generally expressed the opinion that the earth was at the time not in a position to render the meteors visible in this longitude to any great extent.

Mr. Briggs referred to the agglomeration of small coal as a manufacture in successful operation in Belgium, as an instance of the feasibility of agglomerating the fine coal of Pennsylvania.

Pending nominations Nos. 552, 553, 554, and 557, and new nominations Nos. 558 to 567, were read.

On motion of Mr. Fraley, the President was empowered to fill any vacancy that might occur in the Committee to aid the Trustees of the Building Fund.

And the Society was adjourned.

Stated Meeting, December 21, 1866.

Present, seventeen members.

Dr. WOOD, President, in the Chair.

Mr. R. P. Uhler, a member of corresponding Society, was introduced.

Letters were read from the Holland Society of Sciences, at Harlem; from the Literary and Philosophical Society of Manchester, April 14; from the Society of Natural Sciences at Marburg, September 28, 1866, announcing the transmission of donations, and from the Imperial Geographical Society of St. Petersburg, July 25 and August 6, 1866; from the Imperial Geological Institute at Vienna, April 26, 1866; from the Royal Academy at Brussels, Nov. 20, 1865; from the Royal Academy at Amsterdam, Nov. 23, 1865; from the Physical Society at Berlin; from the Royal Society at Gottingen, March 22, 1866; from the Royal Belgian Academy, November, 1865, and February 14, 1866; from the Royal Geological Society of Ireland, November 29, 1865; from the Museum of the Antiquaries of Scotland, January and February, 1866; from the Society of Antiquaries of London, February 2, 1865, and August 4, 1866; from the Essex Institute of Salem, Mass., July 5, 1866; from the Massachusetts Historical Society, April 2 and August 29, 1866; from the Public Library at Boston, September 12, 1866; from the American Antiquarian Society at Worcester, Mass., July 5 and July 11, 1866; from the University of Toronto, March 19, 1866; from the Buffalo Natural History Society, November 22, 1866; from the Historical Society of Chicago, March 20, 1866; from the American Oriental Society of New Haven, March, 1866; from the New York Historical Society, July 5 and July 11, 1866; from the New Jersey Historical Society, July 5, 1866, and from the Historical Society of Pennsylvania, June 25 and July 18, 1866, severally acknowledging the receipt of publications of this Society.

Donations for the Library were announced as follows: From the Imperial Society of Naturalists of Moscow; the

German Geological Society of Berlin; A memoir of the Anniversary of the Stoltzen System of Stenography; the Imperial Royal Geological and the Imperial Royal Geographical Societies at Vienna; the Society of Naturalists of Marburg; the Royal Observatory of Brussels; the Holland Society of Sciences at Harlem; the Royal Academy of Science of Belgium; Pamphlets on various subjects from A. Quetelet and the Belgian Academy; from the Batavian Society of Experimental Philosophy; the Netherland Legation; the Royal Irish Academy; the Royal Geological Society of Ireland; the Literary and Philosophical Society of Manchester; the Royal Society of London, and the Chemical Society of London; the Dublin Quarterly Journal, and the Medical News and Library of Philadelphia.

Judge Sharswood announced the death of Prof. Vethake, a member of the Society, which occurred on the 16th inst., in the 76th year of his age.

Dr. Hayden made some remarks in regard to the geology of the Missouri Valley, and exhibited a section of the Missouri River from the mouth of the Platte River to Fort Benton, and several geological maps of that region.

He called the attention of the Society to the simplicity of the structure of all this Prairie Country. The rocks of the different great periods seemed to lie in basins, as is shown by the colored section. By referring to the map, it will be seen that the coal-bearing rocks are largely developed along the Missouri River, from a point below the mouth of the Kansas River, at Leavenworth City, Nebraska City, and other places; but that by a slight dip towards the northwest, they pass beneath the water-level of the river about 30 miles above Council Bluffs. These rocks do not appear again in their westward extension, until they are revealed by the upheaval of the Rocky Mountains and their outliers, the Black Hills, &c. They are here exposed, by upheaval, with a comparatively diminished thickness, varying from 200 to 1500 feet, forming a narrow belt or zone around the granitic nucleus. Overlying the Carboniferous rocks along the Missouri are a series of formations of Cretaceous age, which have been separated into five divisions, Nos. 1, 2, 3, 4, and 5. Beds of intermediate age are wanting. These formations have also received

special geographical names,* indicating points where each division is shown in its largest development. No. 1 is called the Dakota group, because it was first described along the Missouri River, near Dakota Territory, and there exhibits its typical characters. No. 2, or Fort Benton group, has a thickness of 800 to 1000 feet near Fort Benton, while along the Missouri River, near the mouth of the Vermilion, where it was first discovered, it never attains a thickness of more than 80 or 90 feet. No. 3 is called the Niobrara group, as it presents its typical characters and is most finely shown along the Missouri, near the entrance of the Niobrara River. No. 4 is named the Fort Pierre group, from the fact that this point is located near the centre of its greatest thickness. No. 5 is denominated the Fox Hills group, from an elevated ridge between Moreau and Grand Rivers, where it contains a great abundance of its characteristic organic remains. This ridge continues a little east of north, crossing the Missouri River near the mouth of Cannon-ball River. All these divisions reappear along the slope of the mountains, showing quite clearly that they dip beneath the Tertiary beds in the basin-like form before described.

Then come the great Tertiary basins, which may be given in the order of their supposed age, commencing with the oldest: 1st. The Judith River Basin occupies an area of about 40 miles in length from east to west, and 15 to 20 from north to south. 2d. The Great Lignite Basin occupies all the country from Heart River to the Musselshell, most of the Valley of the Yellowstone, extends for an unknown distance northward, into the British Possessions, and southward at least to the North Platte, and it is supposed that the Lignite beds near Pike's Peak and Raton Pass, in New Mexico, are of the same age. The limits of this great basin have not yet been strictly defined. 3d. The Wind River deposits occupy an area of about 100 miles in length and 40 to 50 in breadth. 4th. The Basin of the "Mauvaises Terres," or Bad Lands, of White River, cover a vast region, at least 100,000 square miles, and from the scattered hills on both sides of the Missouri River, this great fresh-water lake must have spread over 150,000 square miles. It is supposed, from the evidence already secured, that these lakes were not contemporaneous, but succeeded each other in the order enumerated.

Dr. H. remarked, in regard to the probable existence of Coal in the Coal measure rocks from Leavenworth City to Omaha, he be-

* Meek and Hayden, Proceedings Academy Nat. Sciences, 1861.

lieved that this portion of the country formed the western rim of the great coal basin, and that the coal beds had so thinned out in their western extension, that no seams will be found thick enough to pay the cost of opening. At Omaha City the Pacific Railroad Company are sinking an Artesian Well several hundred feet, with the hope of passing through a bed of coal, but it is hardly probable that they will succeed.

The Permian rocks of Kansas are also quite instructive. Their organic remains show clearly that these beds are only a prolongation of the Carboniferous period, and as such they are classified in Dana's Manual of Geology. There is no physical break between the well-known Carboniferous beds and those of the Permian; and the well-known Coal measure fossils gradually fade out, and the well-marked Permian forms increase, as you pass upward, until only about 200 feet of rocks contain exclusively Permian forms. This is an important lesson in geology, inasmuch as there seems to be a bridging over of one of the chasms or breaks in the great divisions of the geological scale.

The Dakota group also presents an instructive lesson in the angiosperm dicotyledonous plants, which have been preserved in its strata. It is well known to geologists that up to the present time no well-marked dicotyledonous plants have been found in rocks older than the Cretaceous. The sandstones of this group at Tekama, Blackbird Hill, Sioux City, have yielded a large number of species. Here leaves were first detected by Dr. H. in 1857, at Blackbird Hill. Not long after this time Mr. Meek forwarded some tracings of these leaves to Prof. O. Heer, of the University of Zurich, Switzerland, one of the most eminent authorities in fossil botany in Europe. He at once pronounced them of Tertiary age, and on the strength of that opinion Mr. Marcou published a small memoir, in which he affirmed that Mr. Meek and Dr. H. had confounded strata of different ages, and that the plants must have come from Tertiary rocks.

In 1863, Mr. Marcou, accompanied by an eminent Italian geologist, Prof. Capellini, of the University of Bologna, made a tour to the West, ascending the Missouri River as far as the mouth of the Big Sioux River; and on their return to Europe, published the results of their observations in two small memoirs, in which they both freely acknowledged the correctness of the previous labors of Mr. Meek and Dr. H. Prof. C. made a fine collection of plants from the Dakota group, which he placed in the hands of Prof. Heer, for ex-

amination, who, after a careful study of them, affirmed that these rocks are Cretaceous. Thus a long-disputed point has been set at rest.

The vegetable remains of this formation are peculiarly interesting to the geologist, from the fact that among them are forms so closely resembling the leaves of the fruit and forest trees of the present time,—a very marked and important advance in the progress of the vegetation of the ancient world. So far as can be seen from the collections already made, they do not seem to exhibit as high a type of organization as those of the same class of the present day. There seem to be no serrations on the edges of the leaves or other attempts at ornamentation, which are so finely shown in those of our living forest trees. The inference is, therefore, that this flora illustrates the great law of progress: commencing with great simplicity of form, and advancing, step by step, to greater complexity and beauty.

Dr. H. also spoke of the interesting fossils he had collected during the past season from the Fort Pierre group, at Sage Creek and other localities in that vicinity. These fossils are so abundant at certain localities, extending in continuous lines or belts for long distances across the country, and so well preserved, that one might regard these shell zones as the shores of the great Cretaceous sea.

Dr. H. also exhibited some thin slabs of fine-grained ferruginous sandstone, from the head-waters of the Teton River, eastern side of the Bad Lands. They belong to the upper part of the Fox Hills group, near the close of the Cretaceous period of the Upper Missouri. They were covered with very distinct trails of gasteropoda and marine worms. These specimens seem to indicate a shore-line, from which there was an ebb and flow of the tide, and as the waters receded these little animals left behind, would struggle over the soft sand toward the water, leaving their peculiar trails, which would be filled up with sediment by the returning tide.

The fact of the existence of four and perhaps five great fresh-water lakes in the Upper Missouri country during the Tertiary period, is a matter of the highest interest, and it is our privilege to collect all the evidence possible, and thus restore to our minds the ancient physical geography of this region. We cannot doubt that during all the different geological epochs there were lakes, rivers, seas, and oceans, islands, continents, and mountains, and that it is the most important mission of the geologist to restore the physical geography of these different epochs to the eye of science.

Prof. Cresson made some remarks upon the great fall of temperature that occurred the day previous to the meeting, accompanied by a sudden rise of the barometer, similar to that observed on the 7th and 8th of January of this year, when these phenomena were exhibited over a large extent of territory, embracing all the Northern and Middle States of the Union.

He also described a curious effect of the extreme cold, observed by him this morning in Schuylkill County, where the thermometer stood at 15° below zero of Fahr. Just after daybreak he saw the steam thrown off by the large engines of a colliery rising in a vertical column of dense cloud some 300 feet or more in height, and then float off horizontally from the top of the column in a stratum some two or three miles long, where it rested, without much change of level, for a long time.

The phenomenon being, in his opinion, the result of the sudden freezing of the vesicular mass and the entanglement in it of a quantity of air, of which the temperature was so much higher than that of the surrounding atmosphere, to keep the whole afloat, as he supposed to be the case in most of the lofty mackerel clouds.

The Committee of Finance made their report, and recommended the usual appropriations for the expenses of the Society during the ensuing year, which were adopted.

Pending nominations Nos. 552 to 567 were read.

And the Society was adjourned.